

CLAIMS

1. A polymetaphenylene isophthalamide-based polymer porous film with a gas permeability of 0.2-1000 ml/sec, which retains at least 60% of its gas permeability after
5 heat treatment at 350°C for 10 minutes compared to before treatment, while also having a porous structure with a porosity of 60-80%.

2. A polymetaphenylene isophthalamide-based polymer
10 porous film having a porous structure with a porosity of 60-80% and a cross-sectional pore laminar coefficient of 2.5 or greater, and having a specific Young's modulus of 200-800 Km in at least one direction.

15 3. A polymetaphenylene isophthalamide-based polymer porous film with a gas permeability of 0.2-1000 ml/sec, which retains at least 60% of its gas permeability after heat treatment at 350°C for 10 minutes compared to before treatment, while also having a porous structure with a
20 porosity of 60-80% and a cross-sectional pore laminar coefficient of 2.5 or greater, and having a specific Young's modulus of 200-800 Km in at least one direction.

4. A porous film according to any one of claims 1
25 to 3, which has a thickness of 1-10 μm and is self-supporting.

5. A polymetaphenylene isophthalamide-based polymer porous film containing inorganic whiskers and having a porosity of 10-80% and a specific Young's modulus of 200-5000 Km in at least one direction.

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6. A polymetaphenylene isophthalamide-based polymer porous film according to claim 5, wherein the weight ratio of the polymetaphenylene isophthalamide-based polymer to the whiskers is 50:50 to 99:1.

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7. A polymetaphenylene isophthalamide-based polymer porous film according to claim 5 or 6, wherein the inorganic whiskers have a long axis dimension L of 0.1-100 μm , a short axis dimension D of 0.01-10 μm and an L/D ratio of 1.5 or greater.

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8. A process for the production of a polymetaphenylene isophthalamide-based polymer porous film, comprising casting a dope prepared by dissolving a polymetaphenylene isophthalamide-based polymer in an amide-based solvent, and coagulating it in a coagulating bath comprising an amide-based solvent containing a non-solvent for said polymer.

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9. A process according to claim 8, wherein the concentration of the amide-based solvent in the

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coagulating bath is 30-80 wt% and the temperature is 0-98°C.

10. A process according to claim 8 or 9, wherein the non-solvent for the polymetaphenylene isophthalamide-based polymer is water.11. (previously presented): A process according to claim 8, wherein the dope prepared by dissolving a polymetaphenylene isophthalamide-based polymer in an amide-based solvent contains no inorganic salts.

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11. A process according to claim 8, wherein the dope prepared by dissolving a polymetaphenylene isophthalamide-based polymer in an amide-based solvent contains no inorganic salts.

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12. A process according to claim 8, wherein after coagulation, the porous film is rinsed with water, dried and then stretched to a factor of 1.3-5 in the uniaxial direction or to a factor of 1.3-10 in the orthogonal biaxial\ directions on an area scale, at a temperature of 270-340°C.

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13. A process according to claim 8 wherein, after coagulation, the porous film is further stretched in a stretching bath comprising an amide-based solvent containing a non-solvent for the polymetaphenylene isophthalamide-based polymer.

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14. A process according to claim 13, wherein the concentration of the amide-based solvent in the stretching bath is 5-70 wt% and the temperature is 0-98°C.

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15. A process according to claim 8, wherein the coagulation is followed by immersion in a bath comprising an amide-based solvent containing a non-solvent for the polymetaphenylene isophthalamide-based polymer, with an
10 amide-based solvent concentration of 50-80 wt% and a temperature of 50-98°C.

16. A process according to claim 15, wherein the dimethylformamide-insoluble portion of the porous film
15 after immersion is 10% or greater.

17. A process according to claim 15 or 16, wherein after the immersion the porous film is rinsed with water, dried and then heat treated at a temperature of 290-
20 380°C.

18. A process according to claim 15 or 16, wherein after the immersion the porous film is rinsed with water, dried and then stretched to a factor of 1.3-5 in the
25 uniaxial direction or to a factor of 1.3-10 in the orthogonal biaxial directions on an area scale, at a temperature of 270-380°C.

19. A process according to claim 15 or 16, wherein
after the immersion the porous film is further stretched
in a stretching bath comprising an amide-based solvent
containing a non-solvent for the polymetaphenylene
isophthalamide-based polymer.

20. A process according to claim 19 wherein, after
the stretching, the porous film is rinsed with water,
dried and then heat treated at a temperature of 290-
380°C.

21. A process according to claim 19, wherein the
concentration of the amide-based solvent in the
stretching bath is 5-70 wt% and the temperature is 0-
98°C.

22. A process according to claim 8, wherein the
dope used is one in which inorganic whiskers are
dispersed and a polymetaphenylene isophthalamide-based
polymer is dissolved in an amide-based solvent.

23. A process according to claim 22, wherein the
weight ratio of the polymetaphenylene isophthalamide-
based polymer to the whiskers is 50:50 to 99:1.

24. A process according to claim 22 or 23, wherein
the inorganic whiskers have a long axis dimension L of

0.1-100 μm , a short axis dimension D of 0.01-10 μm and an L/D ratio of 1.5 or greater.

25. A porous film comprising at least two layers
5 including a polymetaphenylene isophthalamide-based polymer porous layer and a heat-melting thermoplastic polymer porous layer.

26. A porous film according to claim 25, wherein
10 the thermoplastic polymer is a polyolefin with a molecular weight of 400,000 or greater.

27. A porous film according to claim 25, wherein
15 the thermoplastic polymer is a polyvinylidene fluoride-based polymer.

28. A porous film according to claim 27, wherein
the polyvinylidene fluoride-based polymer is a copolymer composed mainly of vinylidene fluoride and a perfluoro
20 lower alkyl vinyl ether.

29. A porous film according to any one of claims 25
to 28 wherein, at elevated temperatures, the thermoplastic polymer layer melts and plugs the pore
25 gaps, while the polymetaphenylene isophthalamide-based polymer layer retains its shape without melting.

30. A process for the production of a porous film which comprises forming a porous layer of a polymetaphenylene isophthalamide-based polymer onto one or both sides of a porous film made of a heat-melting thermoplastic polymer, or forming a porous layer made of a heat-melting thermoplastic polymer onto one or both sides of a porous film of a polymetaphenylene isophthalamide-based polymer.

31. A battery separator comprising a porous film according to any one of claims 25 to 28.

32. A lithium ion battery employing a battery separator according to claim 31.

33. A method of using a porous film according to any one of claims 1-3 and 5-6 comprising placing said porous film as a battery separator between a positive electrode and a negative electrode in a battery.

34. A lithium ion battery comprising a battery separator situated between a positive electrode and a negative electrode, wherein said battery separator comprises a porous film according to any one of claims 1-3 and 5-6.